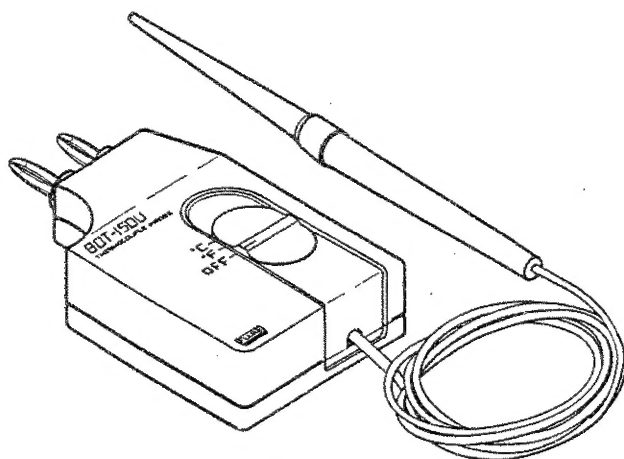




Instruction Sheet

80T-150U

Universal Temperature Probe



INTRODUCTION

The Model 80T-150U Universal Temperature Probe is a self-contained temperature-to-voltage converter. The probe is designed to provide a direct temperature reading when it is connected to any high impedance DMM that is capable of 1 mV resolution and at least a 300-count full scale readout capability. Output is 1 mV per degree (Celsius or Fahrenheit). Two switch-selected temperature output scalings are provided: -50 to +150°C or -58 to +302°F. The probe will stand off 350V dc or peak ac.

The unit is housed in two separate but attached assemblies: a temperature probe and a temperature-to-voltage converter. The probe contains the temperature-sensing element and is electrically connected to the temperature-to-voltage converter through a 46-inch shielded cable. A three-position switch on the converter acts as a power switch and is used for selecting Celsius or Fahrenheit scaling for the output. Two banana plugs with standard 0.75-inch spacing are provided for connecting the 80T-150U to the DMM.

Operating power for the 80T-150U is derived from a standard 9V battery. Typically, an alkaline battery provides more than 1600 hours of continuous operation before replacement is necessary. An OFF switch is provided on the temperature-to-voltage converter to allow battery conservation when the unit is not in use. In addition, the OFF position of the power switch allows the battery condition to be determined via the external DMM.

Temperature is measured by exposing the probe tip directly to the material to be measured (non-corrosive liquid, gas, or solid). A direct temperature reading is displayed on the DMM.

SPECIFICATIONS

The 80T-150U will achieve rated accuracy when it is used with any 0.25% DMM that has an input impedance of $\geq 1 \text{ M}\Omega$.

ELECTRICAL

Measurement Range: -50 to +150 degrees Celsius
-58 to +302 degrees Fahrenheit

Accuracy:

AMBIENT °C	ACCURACY
+15 to +35°C	$\pm 1^\circ\text{C}$ from 0 to +100°C, decreasing linearly to $\pm 3^\circ\text{C}$ at -50 and +150°C
0 to 15°C and +35 to +50°C	$\pm 2^\circ\text{C}$ from 0 to +100°C, decreasing linearly to $\pm 4^\circ\text{C}$ at -50 and +150°C
AMBIENT °F	ACCURACY
+59 to +95°F	$\pm 1.8^\circ\text{F}$ from +32 to +212°F, decreasing linearly to $\pm 5.4^\circ\text{F}$ at -58 and 302°F
+32 to +59 °F and +95 to +122 °F	$\pm 3.6^\circ\text{F}$ from +32 to +212°F, decreasing linearly to $\pm 7.2^\circ\text{F}$ at -58 and 302°F

Sensitivity (80T-150U output): 1 mV dc / °C or °F

Voltage Standoff: 350V dc or peak ac

Settling Time: 5.5 seconds to settle within 2° for a 50° change

ENVIRONMENTAL

Ambient Operating Range for Unit: 0 to +50°C (+32 to +122°F)

Maximum Temperature Probe Body and Cable: +70°C (160°F) See Probe Limitations

Storage Temperature for Unit: -40 to +70°C (-40 to +160°F)

Humidity: 0% to 90% (0°C to 35°C) noncondensing
0% to 70% (35°C to 50°C) noncondensing

Altitude: Operating: $\leq 10,000$ feet
Storage: $\leq 50,000$ feet

Application Force: 20 pounds maximum (probe tip to measured surface)

GENERAL

Weight: 5.7 ounces, 161.5 grams

Overall Length: 53.8 inches, 1.36 meters

Battery: Standard 9V battery (NEDA #1604, 6F22, 006P)

Battery Life: 1600+ hours, typical (Alkaline Battery), 6.5V minimum

Output Termination: Standard 0.75-inch spaced double banana plug

OPERATING NOTES

The following paragraphs are intended to familiarize the operator with the 80T-150U. The operator should read these paragraphs before attempting to operate the probe.

Probe Limitations

The 80T-150U probe is constructed of a highly durable plastic and is suitable for measuring the temperature of liquids, gases, and solid surfaces up to 150°C. When measuring temperature, observe the following precautions to prevent damage to the probe:

1. Do not expose the probe end (probe tip plus about 2 inches of the probe body) to temperatures exceeding +150°C (302°F). The remainder of the probe body should not be exposed to temperatures above +70°C (160°F).
2. For liquid measurements, recommended applications range from water, lubricants, and fuels to most solvents. Liquids as shallow as ½ inch can be measured since the temperature sensor is in the probe tip.

WARNING

TO AVOID ELECTRICAL SHOCK, DO NOT USE THIS INSTRUMENT WHEN VOLTAGES EXCEEDING 350V DC OR PEAK AC ARE PRESENT. THE PROBE TIP IS ELECTRICALLY CONNECTED TO THE OUTPUT TERMINALS.

CAUTION

Long-term exposure of the probe to corrosive environments will result in pitting and deterioration of the aluminum probe tip.

Error Sources

When the probe tip is applied to a solid surface, it draws or sinks heat from the surface. Therefore, if the measured surface has a low mass (e.g., a transistor case), the indicated temperature may be lower than the actual temperature.

Similarly, a steady-state error or gradient exists between the measured surface and the sensing device in the probe tip. This is due to the flow of heat from the measurement surface to the probe body. The effect of the steady-state error increases as the differential between ambient and surface temperature increases.

To determine the actual surface temperature of a device, both the heat-sinking and steady-state errors must be considered. The correction curve given in Figure 1 approximates the effect of both error sources on TO-3, TO-5, and TO-18 transistor cases.

RF signals applied to the 80T-150U probe tip can also cause errors in temperature measurement. Figure 2 defines the rf signal limits that can be tolerated without degrading measurement accuracy.

OPERATION

Use the following procedure to operate the 80T-150U probe:

1. Connect the banana plugs on the 80T-150U to the input terminals of a high impedance DMM. Observe polarity.
2. Select a dc voltage range that will provide at least 1 mV resolution (1 mV/degree) and a full scale readout that will encompass the expected temperature. The 2V range of a 3 1/2-digit DMM is adequate. Ignore readings of less than 1° when a more sensitive DMM is used.
3. Set the 80T-150U power switch to °C or °F, and energize the DMM.
4. Firmly touch the probe tip to the surface to be measured, or expose it to a liquid or gas. The DMM will display the temperature in degrees. Vary the probe angle and pressure when measuring solid surface temperatures. The highest stabilized reading will be the most accurate. (See the following measuring technique.)

CAUTION

The force exerted on the probe tip should not exceed 20 pounds.

MEASURING TECHNIQUE

Here are some suggestions for improving the accuracy of your temperature measurements:

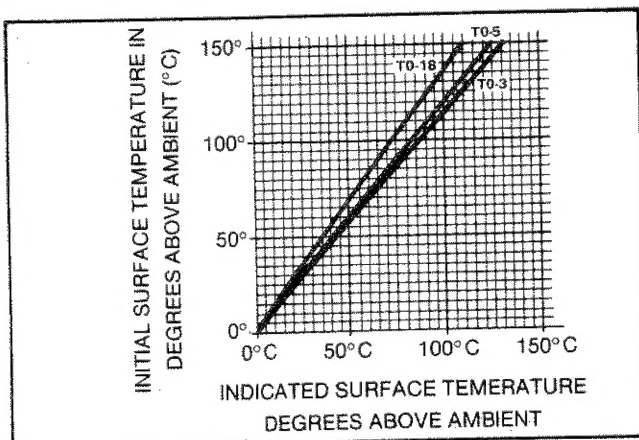


Figure 1. Initial Case Temperature Above Ambient vs. Meter Reading Above Ambient

1. When measuring higher than ambient temperatures, adjust the connection between the probe and the surface until you get the highest temperature reading.
2. When measuring lower than ambient temperatures, adjust the connection between the probe and the surface until you get the lowest temperature reading.
3. When measuring near ambient temperatures, make the reading when the multimeter readout is most stable.

THEORY OF OPERATION

The Model 80T-150U uses the negative temperature coefficient of a semiconductor (P-N) junction to measure temperature. The PN junction is thermally integrated into the probe tip and comprises one leg of a bridge circuit as shown in the simplified circuit diagram of Figure 3. One 9V battery is used to power both the bridge circuit and operational amplifier AR1. Since the bridge must be balanced to provide 0°C and 0°F indications, separate range or temperature scale resistors R7 and R6 are included in the bridge circuit. When R6 and R2 are shorted by S1, the °C scale is selected and the bridge is calibrated by R3 to null at 0°C. Conversely, when S1 is open, the 0°F scale is selected, and the bridge is calibrated by R2 to null at 0°F. Deviations above and below 0° provide a bridge output of approximately 2.45 mV/°C.

Operational amplifier AR1 is used to measure the bridge output and scale it to a 1 mV/degree signal. Since the °C and the °F scale are sloped differently, the scale for AR1 must be matched with the scale selected for the bridge circuit. Shorting resistors R15 and R18 selects the °C scale. Conversely, when S1 is open, the °F scale is selected. Resistor R4 calibrates both scales.

The output voltage used to drive the external voltmeter is taken from the output of AR1 (P2) and the reference side of the bridge (P1). Since AR1 is operating as an inverting amplifier, its output is used as the low input to the voltmeter. This enables the voltmeter to display an increase in temperature as an increase in voltage.

GENERAL MAINTENANCE Access Information

The battery and the calibration pots are located on the interior of the temperature-to-voltage converter assembly. Access to these locations is accomplished by removing the screw from the bottom side of the assembly and removing the top of the plastic case.

Battery Condition Test

1. Set the power switch to the OFF position.
2. Connect the 80T-150U to the DMM.
3. Set the DMM to the 200 or 300 mV dc range.
4. Read the battery test voltage on the DMM. A minimum reading of 100 mV is acceptable and indicates that approximately 100 hours of battery life remain.

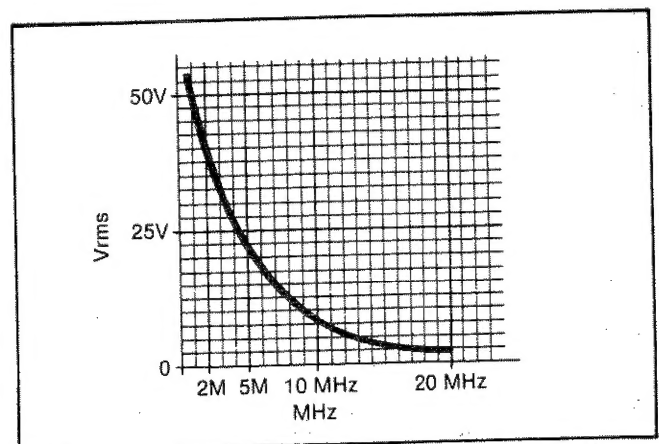
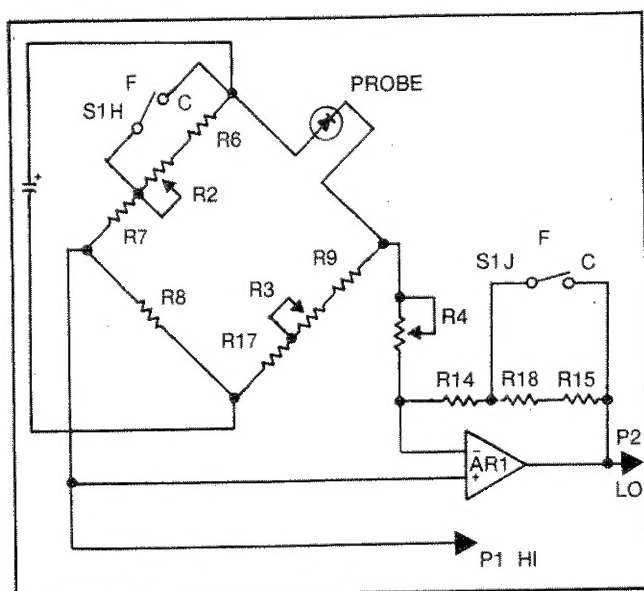


Figure 2. Maximum Signal RF Limits (Vrms) at Probe Tip



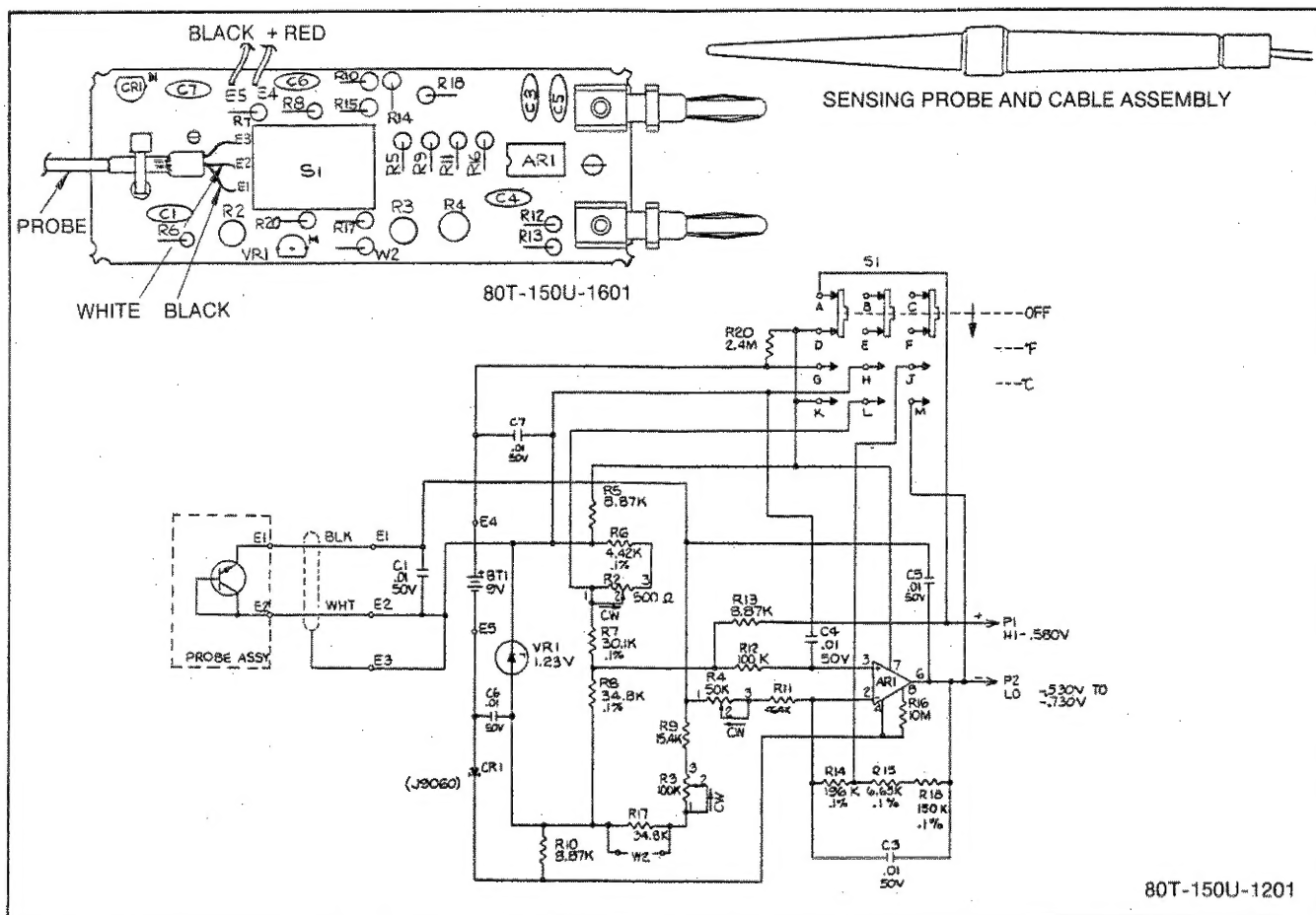


Figure 4. 80T-150U Temperature Probe Schematic

Figure 5. List of Replaceable Parts

REFERENCE DESIGNATOR	JF P/N	DESCRIPTION
CR1	741512	DIODE,CURRENT REG.
VR1	729202	IC,1.23V,150 PPM T.C.,BANDGAP REF
C1,3-7	697284	CAP,CER,.01UF,50V
R2	733642	RES,VAR,CERM,500 OHMS,.3W
R3	721829	RES,VAR,CERM,100K,.3W
R4	769950	RES,VAR,CERM,50K,.3W
R16	720870	RES,CF,10M,5%,1/4W
R20	772566	RES,CF,2.4M,5%,1/4W
R5,10,13	658922	RES,MF,8.87K,1%,1/4W
R6	772525	RES,MF,4.42K,1%,1/4W
R7	772574	RES,MF,30.1K,1%,1/4W
R8	772582	RES,MF,34.8K,1%,1/4W
R9	772038	RES,MF,15.4K,1%,1/4W
R11	772020	RES,MF,464K,1%,1/4W
R12	757807	RES,MF,100K,1%,1/4W
R14	772533	RES,MF,196K,1%,1/4W
R15	772558	RES,MF,150K,1%,1/4W
R17	772319	RES,MF,34.8K,1%,1/4W
R18	772541	RES,MF,6.65K,1%,1/4W
W2	682575	RES,CF,.02,1/4W
AR1	418913	IC,OP AMP,BIPOLAR
S1	772301	SWITCH,SLIDE,3P3T
	738179	CONNECTOR,BATTERY
	736033	PLUG,BANANA
	747501	SCREW,PHPO,4-40X1/4
	431023	SENSING PROBE AND CABLE
		ASSY 80T-150-7001K
	172080	CABLE TIE
	778050	CASE,BOTTOM
BT1	696534	BATTERY,NEDA 1604,9V
	129882	SCREW,PHP,4-40X3/16
	769034	CASE, TOP
	735860	COVER, SWITCH
	428441	SHOCK ABSORBER

WARRANTY ONE YEAR LIMITED WARRANTY

John Fluke Mfg. Co., (Fluke) warrants your accessory to be free from defects in material and workmanship under normal use and service for 1 year from the date of purchase if you are the original purchaser. The warranty does not apply to batteries or fuses or when the accessory has been misused, altered, or damaged by accident or abnormal conditions of operation.

For warranty service, send the accessory with a description of the difficulty, postage prepaid to a Fluke Service Center. Fluke assumes no risk for damage in transit. Fluke will, at our option, repair or replace the defective instrument free of charge. However, if we determine that the failure was caused by misuse, alteration, accident, or an abnormal condition of operation, you will be billed for the repair. The repaired accessory will be returned, transportation prepaid.

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